



Masterclass Biorenewables | TK @ TU Delft

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14 January 2013



## contents

- biobased economy: can we and should we ?
- what - global and regional drivers ?
- how - scale and scope: 'drop-in' or dedicated ?
- innovation strategy
- back to NW Europe



## Global drivers for a BBE ?



- more people with more wealth
- less **nett** GHG emission (global warming) and/or climate adaptation
- politics (security of oil/gas supply)
- innovation, rural income and economic development
- increasing (*and decreasing*) prices of resources
- in time\*, limited fossil reserves
- **add sustainability to food chain**
- **add value to food chain and prevent hunger**

Pick your personal selection !



## Regerakkoord 29/10/'12: groene groei

"De innovatiekracht van het bedrijfsleven, de kennisinstellingen en de overheid zal optimaal worden gericht op de transitie naar een **duurzame economie en groene groei**, mede met het oog op versterking van het concurrentievermogen van de Nederlandse economie. Wij zorgen er voor dat de overheid daarbij een betrouwbare partner is die weet wat ze wil bereiken, besluitvaardig is en in staat vast te houden aan de ingeslagen koers."

"Ons land heeft alles in huis om een betekenisvolle bijdrage te leveren aan de snelle ontwikkeling van nieuwe energiebronnen als zon, wind, biomassa en geothermie: hoogwaardige chemie, een innovatieve agrarische sector, grote havens en een sterke energiesector. Die ontwikkeling is noodzakelijk vanuit het perspectief van klimaatverandering en eindige grondstoffen en is tevens een uitdaging voor innovatieve ondernemingen."

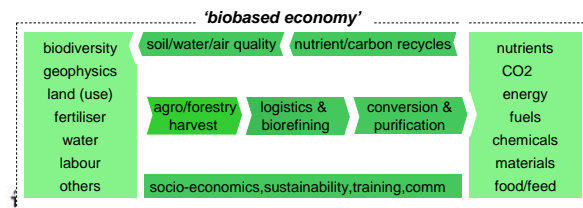
Een groot aantal veel-belovende 'biobased' initiatieven is de laatste jaren al tot stand gekomen. **Deze 'biobased economy' kan een van de pijlers vormen voor groene groei.**"



## ... groene groei & BBE (2)

Regerakkoord: "We kiezen voor een **aandeel duurzame energie in 2020 van 16 procent**. Om innovatie te stimuleren, wordt een optimale mix ingezet van subsidies (SDE+) en mogelijk ook de leveranciersverplichting en bijmeng-verplichtingen."

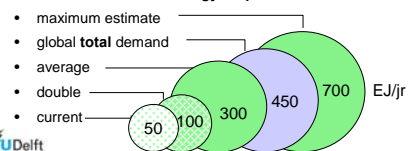
"Biomassa moet zo hoogwaardig mogelijk worden ingezet ('**cascadering**') en de **duurzame productie** en herkomst van biomassa gegarandeerd."



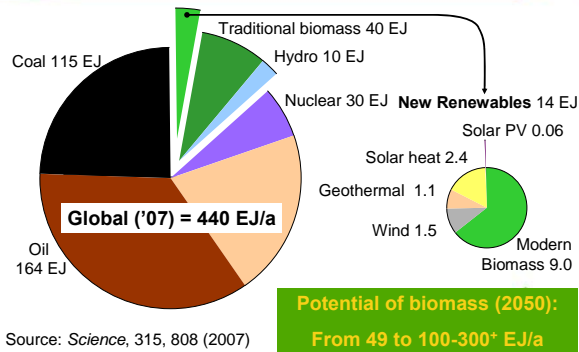
## Scales of biorenewables (illustration)

**Demand** : **stabilisation** CO<sub>2</sub> emissions of transport  
 transport fuels = 2 billion ton (GT)/jr worldwide,  
 annual growth 1.5% or 30 MT/yr (~120 MT/yr biomass)  
 • investments in 2<sup>nd</sup> generation production:  
 → 200 plants or \$ 50 billion every year  
 → every 3 years an extra Port of Rotterdam (360 MT/jr)  
 → (or every 5-6 years new Port of Shanghai)

**Potential: residuals & energy crops**



## Biomass: significant fuel, fiber and food feedstock



## Onderzoek: bijna helft voedsel wordt weggegooid

"Slechte opslag, te strikte uiterste verkooppdata, 'leen-product gratis'-aanbiedingen en de consument die zijn neus ophaalt voor een bruin vlekje zijn allemaal oorzaken van deze verspilling. ..."

Tot 30 procent van de groente die in Groot-Britannië wordt geteeld, wordt niet eens geoogst vanwege het fysieke uiterlijk. Bovendien wordt er **550 miljard kubieke meter** water gebruikt om gewassen te telen die nooit gegeten.

### Weggegooid

Wereldwijd wordt er elk jaar **vier miljard ton** voedsel geproduceerd en hiervan wordt **dertig tot vijftig procent** niet geconsumeerd. In het rapport wordt gesuggereerd dat de helft van het eten dat in Europa en de Verenigde Staten wordt gekocht, ook weer wordt weggegooid.

'In de ontwikkelingslanden vindt het grootste verlies al vroeg in de voedselketen plaats; tussen het veld en de supermarkt', zegt Fox tegen de BBC. 'In de ontwikkelde economieën heeft het alles te maken met slechte marketing en consumentengedrag.'

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Volkskrant / BBC 10/01/13



## 'bio-afval' (2<sup>e</sup> generatie) is nieuwe grondstof

### Afval uit land- en bosbouw

hoofdproduct	GT/jaar	GT/jaar 'afval'/rest	
rijst	0.60	1.10	stro, kaf
graan	0.60	1.00	stro
suiker	0.08	0.70	toppen, bladeren
sojabonen	0.16	0.60	strengels, doppen
mais	0.60	1.20	stengels
hout bouw	0.50	0.30	afval
papier	0.50	0.30+	afval



5.20

giga (miljard) ton per jaar (GT/jaar) = 1 000 000 000 000 kg / jaar

5 GT/jr = 5000 MT/jr x 15 PJ/MT = 75 EJ/jr (EJ = 10<sup>18</sup> J)

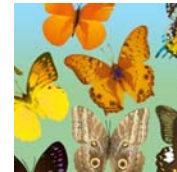
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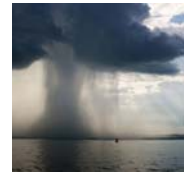
## Competing claims of solutions



Voedselzekerheid  
Voedselprijzen



Biodiversiteit



Klimaat  
Emissies



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## Wet- en regelgeving

- Opschonen afval wetgeving
- Level playing field
- Importheffing industriële grondstoffen herzien
- Coherent overheidsbeleid
- Innovatiebeleid
- Accijns- en belasting- heffing CO2 afhankelijk



Natuurlijke spanning tussen  
innovatie en regelgeving

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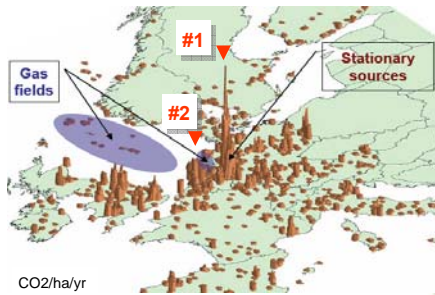
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## NRW and NL are #1 and #2 in Europe



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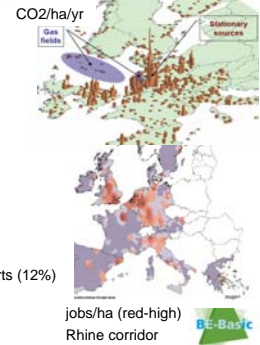
... in GHG emissions!  
(so we have carbon to be recycled)

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## two sides of the coin in NW EU

GDP €512 bn (#20 in 2010)  
chemicals €13bn / 3% of GDP  
€47bn sales / 20% export  
energy €30bn sales  
imports 150 MT oil/gas / 30% EU  
emissions 224 MT CO<sub>2</sub>e/yr

GDP €2500 (#5) 543 bn (#19)  
chemicals €46bn / 8% of NRW GDP  
€145bn sales / 20% export  
energy €33bn of GDP  
chemical €109bn exports / €37bn imports (12%)  
emissions 827 MT CO<sub>2</sub>e/yr

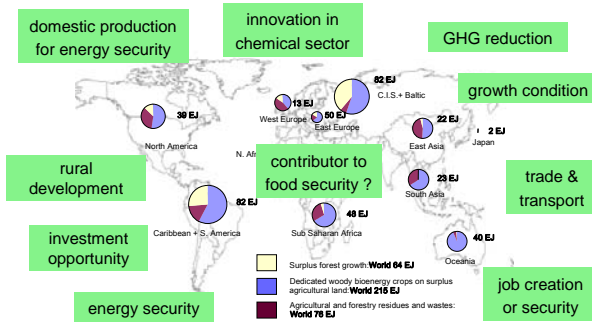


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jobs/ha (red-high)  
Rhine corridor

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## globally different drivers → bottlenecks → debate



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Need for worldwide (honest broker) picture by ...

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## Life in a Delta is ...



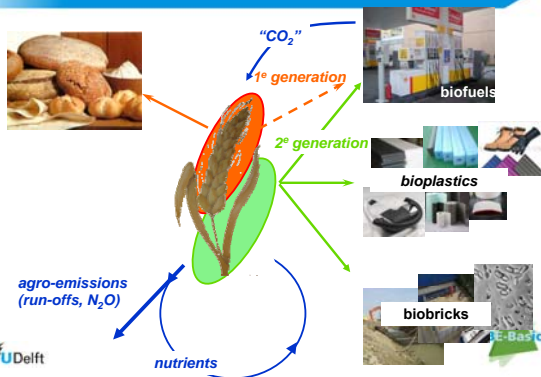
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Leaking earth dams

Dike breach

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## BBE : full economic bio-mass-utilisation



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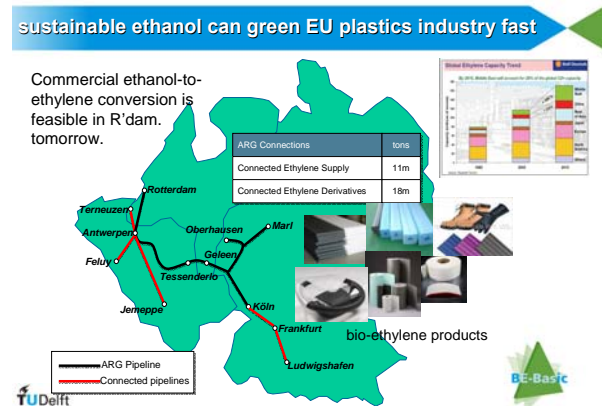
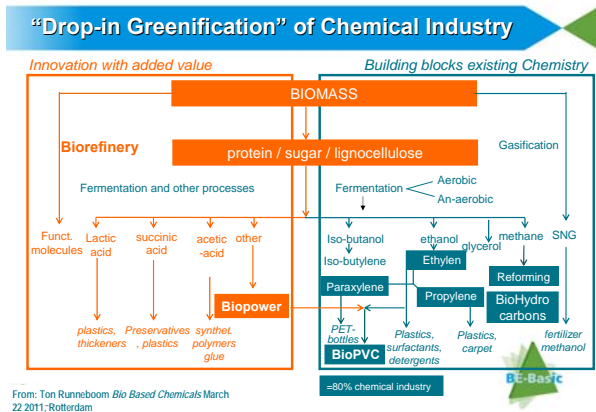
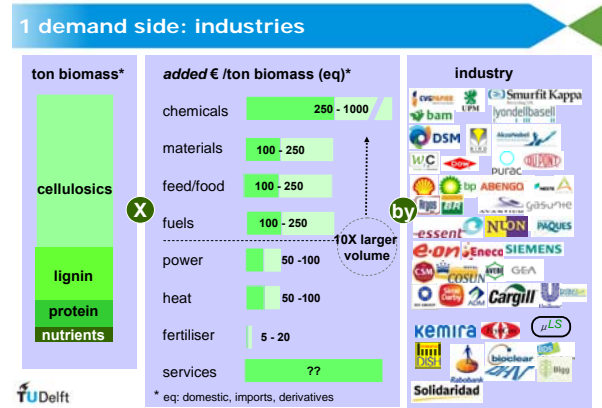
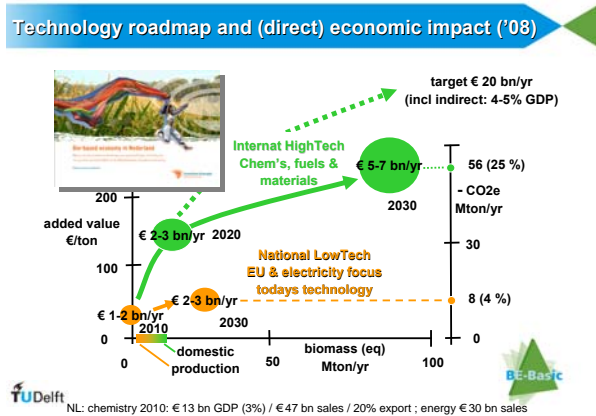
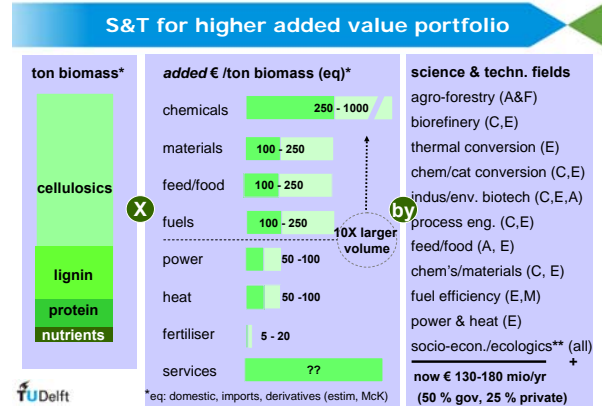
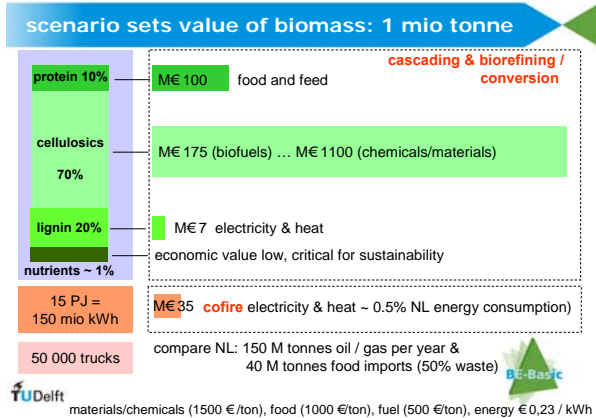
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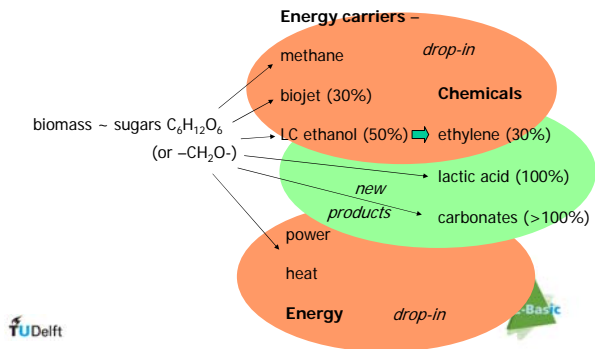
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... but new products may give better mass yields



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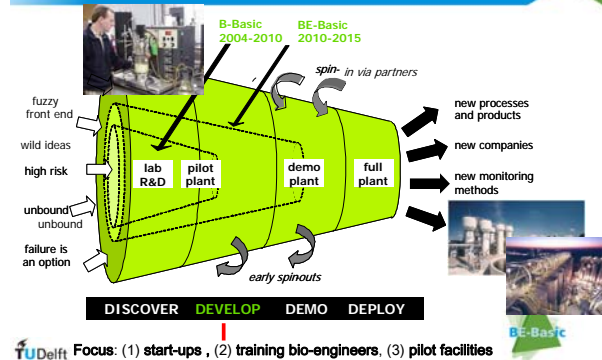


public documents towards TKI-BBE 2011-12



www.tki-bbe.nl

Innovation strategy



Focus: (1) start-ups, (2) training bio-engineers, (3) pilot facilities

### Delft pilot facility for innovations in sustainable bioprocesses

Research consortium BE-Basic has chosen Delft as the site for a unique facility where companies and knowledge institutions can develop new sustainable production processes. These processes serve many purposes, such as converting biomass into useful molecules or fuels. The facility has been specially designed to enable the transition from the laboratory to production on an industrial scale. It allows users to conduct complex operations by linking separate process modules.

**Pre-processing and treatment**  
In the module, dry and wet residues are pretreated and prepared for the fermentation phase.

**Permanent crew**  
The facility has a permanent and experienced crew whose services are available in every case.

**Third-generation Bioprocesses**  
These modules are designed to increase efficiency and lower costs in the production of fuels and biochemicals.

**Training**  
The facility is also a center of expertise where students, researchers and technologists can be trained.

**Downstream processing**  
This is where products are separated and refined. The module can be combined at will to produce all kinds of products, such as raw materials for the construction or chemical industry, or materials for the chemical and pharmaceutical industry.

**BE-Basic**

**TU Delft DSM purac**

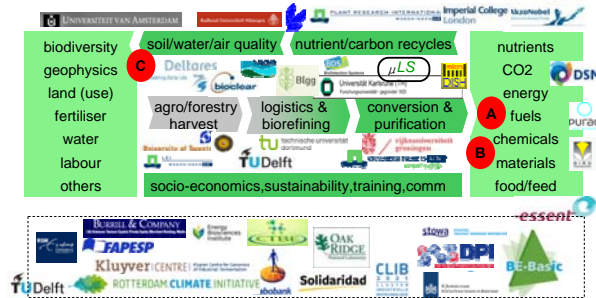
More information: www.be-basic.org

Bioprocess Pilot Facility (Delft Noord campus)



## partners & affiliates

restructure around integral biomass value / sustainability  
 NL agro-forestry is modest (but not nil): international partnering



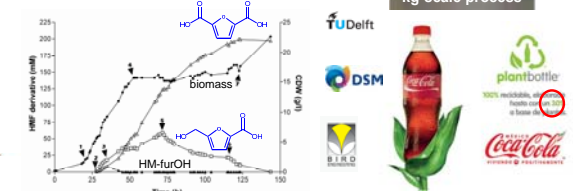
## Synthetic Biology in the real world?

glucose  
 xylose  
 arabinose  
 acetate  
 glycerol  
 fufuranics

commercial product based patent portfolio

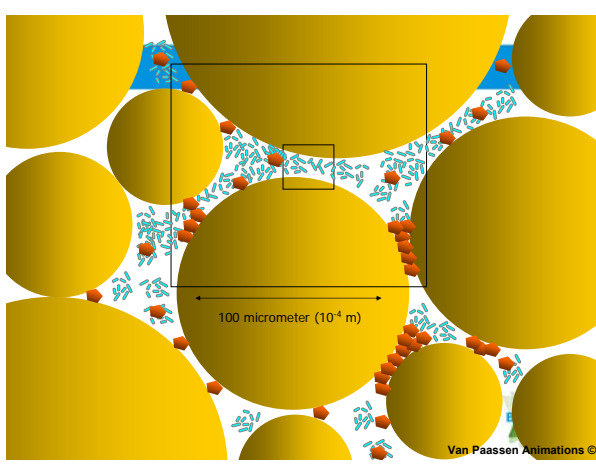
## The other 70% : FDCA for "BioPET"

- Top-12 value-added chemicals from biomass
- Platform chemical - market size 4-12 bn \$/yr
- Replacement for terephthalate in polymers
- Concept in B-Basic (TUD/TNO - '09) – direct production from lignocellulosos
- indust biocat (BIRD Eng /TUD-'09) – bioprocess (BIRD -'10) – invest round - piloting (BE-Basic-'11)



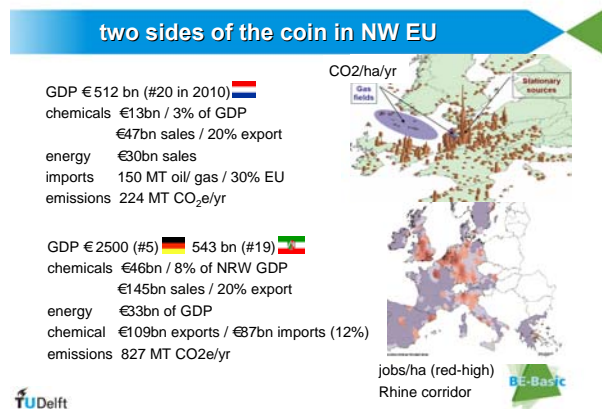
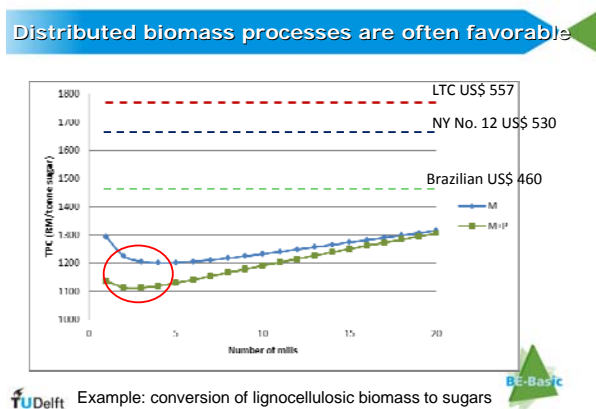
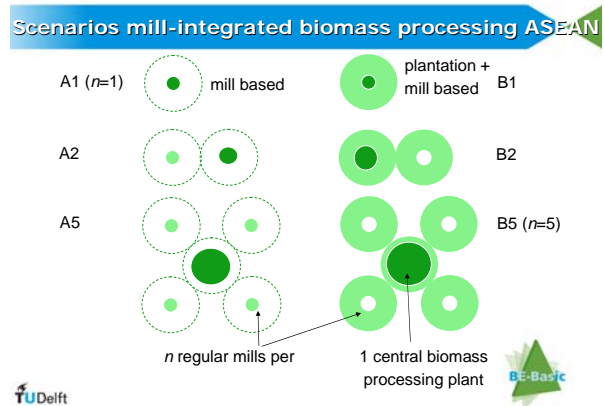
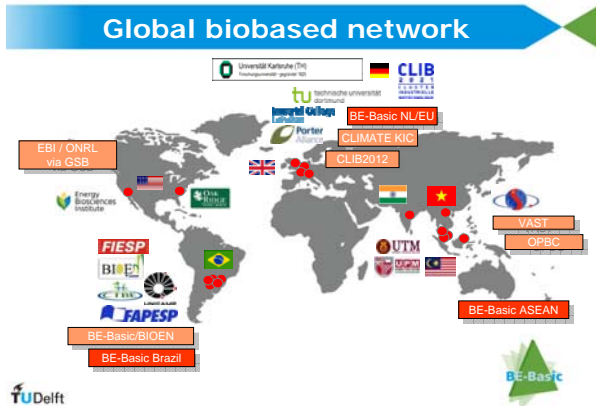
## BiogROUT & bioconcrete: from soft soil to rock solid

In-situ concrete by carbonate fixation



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- ### BBE @ NRW and NL
- similar but not equal positions: strong technology position, leading industries, large asset and infrastructural basis, open economies, substantial downstream market (B2B, retail), increasingly 'green' customer demand
  - sustainability as license to operate – need for single certification system
  - need for secure supply of sustainable biomass (derivatives) including professional commodity market development (APX-ENDEX and beyond)
  - experience *precompetitive* and *competitive* JV etc open innovation models
  - **public-private partnerships** to connect players in biomass value chain and synergy in technology development / cost-risk-facility sharing
- joint integral BBE (technology/markt/...) development
- TU Delft logo and BE-Basic logo are also present.

### Contact us

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Biobased, Ecologically Balanced Sustainable Industrial Chemistry

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